IX. A NEW CROCODILE FROM THE JURASSIC OF WYOMING.

By W. J. Holland, LL.D.

In the summer of the year 1902 Mr. C. W. Gilmore, at that time in the service of the Carnegie Museum as a field collector, succeeded in finding in the Freeze Out Mountains, not far from the "T. B. Ranch," a number of interesting fossils, among them the skull of a crocodile, which the writer provisionally refers to the genus *Goniopholis* Owen,[1] and to which he applies a specific name in honor of the discoverer. The geological horizon from which this skull came is that known as the Atlantosaurus Beds, and the skull was found in a stratum about eight inches above a stratum in which were found commingled remains of dinosaurs belonging to the genera *Morosaurus* and *Diplodocus*.

Class **REPTILIA.**

Order *LORICATA* Merrem.

Suborder EUSUCHIA Huxley.

Family Goniopholidid.e Lydekker.

Genus **Goniopholis** Owen.

Goniopholis ? gilmorei sp. nov.

(Catalogue of Vertebrate Fossils, Carnegie Museum, No. 1339.)

The specimen consists of a skull without the lower jaws. It has been subjected to vertical pressure and is evidently somewhat crushed, so that the transverse dimensions, more particularly in the neighborhood of the orbital and postorbital openings, are greater than they would have been in life and the perpendicular dimensions are less. Otherwise the skull is remarkably well preserved. The entire upper surface is covered with round or angular pits from 2 to 3 mm. in diameter, with intervals of about 1–1½ mm. between them, formed by convex reticularly arranged ridges of the bone, in this respect agreeing perfectly with the generic description given by Owen.

The premaxillaries have not sustained much crushing; the anterior

[1] See *Report of the Eleventh Meeting of the British Association for the Advancement of Science*, page 71.

edge has been broken, and the margin of these bones is not entire. A portion of the posterior margin of the right dental foramen is, however, preserved, showing that the animal possessed the dental foramina, and thus was allied to the genus *Crocodilus* rather than to the genus *Alligator* Cuvier, or the genus *Gavialis* Oppel, the former of which is characterized by the absence of the dental foramina, except possibly in extreme age, and the latter of which is always without these openings. The foveæ on the lower surface of the intermaxillaries which lead from the orifices of the dental foramina are distinctly marked on the under surface of the skull. The snout is strongly constricted at the point where the premaxillaries unite with the maxillaries at the dental incisure. The nasal bones do not reach the narial opening, their anterior ends terminating between the premaxillaries fully three centimeters from the posterior margin of this opening. The alveolar border of the maxillaries extends backward from the point of union with the premaxillaries, in a widening curve, to a point in advance of the orbital cavities. There does not appear to be much, if any, evidence of lateral compression of the skull about the middle of the maxillaries, as is the case in the skull of many species of recent crocodiles, notably *Crocodilus Americanus* Seba. The distortion of the specimen to which the skull has been subjected as the result of vertical pressure may have slightly obliterated the evidence of constriction at the point indicated, in case it existed in life.

The arrangement of the bones composing the roof of the back part of the skull is essentially like that in the recent genus *Crocodilus*. At the point where the mastoid and the parietal bone form the inner and posterior margins of the supratemporal fossæ there are developed well marked convex bony ridges, rising about four mm. in height above the plane of the upper surface of the bones which have been named. This bony ridge is far more strongly marked than in the recent genus *Crocodilus*, where it exists only as a vestige. In other respects the upper surface of the skull shows no points of difference from modern types. The under surface of the specimen preserves, though greatly crushed, the outlines of the bones of the inferior surface of the skull, and these do not seem to diverge in form and arrangement from well known recent types.

With the skull were associated a few teeth. The alveolar border of the maxillaries and premaxillaries is sufficiently perfect to show that the number of teeth was identical with that of the modern genus

Crocodilus, and the arrangement of the teeth and their relative sizes, so far as it is possible to ascertain the facts from the skull under consideration, was the same as in *Crocodilus*. Three successional teeth are preserved on the left hand side of the upper jaw, and the crowns of two larger teeth were found detached from the skull and in the matrix beside it, evidently belonging to the same specimen. These teeth differ somewhat from those of the recent genus *Crocodilus* in being somewhat more compressed and trenchant and not as conical. They are not, however, as obtuse as the teeth described by Owen as belonging to the genus *Goniopholis*, although upon the crown, particularly upon the inner surface, they distinctly reveal the neatly defined longitudinal ridges, which appear to agree with the description given by Owen. The two lateral ridges, one anterior and the other posterior, midway between the convex and concave surfaces, are in both cases sharply defined, and even more sharply than in the genus *Crocodilus*. The larger of the teeth that have been preserved appears to the writer to be, reckoning from the front, No. 10 in the left series.

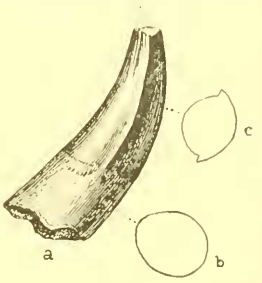

Fig. 1. *a*, Tooth of *G. Gilmorei*, nat. size; *b*, outline of section at base; *c*, outline of section at middle of crown.

DIMENSIONS OF THE SKULL OF GILMORE'S CROCODILE.

Length of skull on median line	38.50 cm.
" " " from posterior extremity of quadrate to end of snout	44.50 "
Transverse diameter of snout across premaxillaries	7.20 "
" " " " at junction of maxillaries and premaxillaries	4.00 "
" " " skull at front of orbits	10.80 "
" " " " at upper ends of mastoids	12.00 "
" " " " at end of quadrates	20.00 "
Longitudinal diameter of left orbital foramen	4.00 "
Transverse " " " " "	5.20 "
Longitudinal " " " postorbital foramen	4.50 "
Transverse " " " " "	3.50 "
Diameter of supratemporal foramen	4.00 "

The specific characters by which this species may be distinguished from the other species of the genus *Goniopholis* described from North America appear to be the very closely pitted superior surface of the bones of the skull, the existence of the elevated ridges partly sur-

rounding the supratemporal foramina, and the less obtuse, elongated, and compressed shape of the teeth.

The writer assigns the species to the genus *Goniopholis* with doubt: first, because no vertebræ were collected, and therefore it is unknown whether the centra were amphicœlous as in *Goniopholis* or not; and, secondly, because the longer, less obtuse, and more trenchant teeth do not fully accord with the generic description given by Owen.

X. PROCAMBARUS, A NEW SUBGENUS OF THE GENUS CAMBARUS.

By A. E. Ortmann, Ph.D.

In a paper just published (*Proc. Amer. Phil. Soc.*, vol. 44, 1905, p. 91), the present writer has divided the genus *Cambarus* into four subgenera: *Cambarus* (*sens. strict.*), *Cambarellus*, *Faxonius*, and *Bartonius*. The first of these (*Cambarus*) is framed to receive the first and second group of this genus, as distinguished by Faxon (excluding *C. pellucidus*, which I refer to *Faxonius*).

In the paper referred to (p. 99), the writer has indicated, that the association of Faxon's first and second group into one subgenus might possibly not be entirely correct, but, that a division according to the number of legs which possess hooks on the ischiopodite, as introduced by Faxon, does not exactly correspond to the natural affinities. He also pointed out, that possibly the shape of the copulatory organs of the males of certain Mexican and Cuban species is more important in this respect.

The Carnegie Museum has lately purchased from Professor J. S. Hine, Columbus, O., a number of specimens of a new species of *Cambarus* from Guatemala (Acc. No. 2778; Cat. Nos. 74,560 and 74,561), belonging in this group, which, in the paper referred to, has been designated as the *digueti*-group (of the section of *C. digueti*), containing hitherto three species (*digueti*, *mexicanus*, *cubensis*). An examination of the copulatory organs of this new form, and their comparison with the figures of these organs of *C. carinatus*, = *digueti* and *cubensis*, with the description of these organs in *C. mexicanus*, and with a male cotype of *C. digueti*, kindly presented by Professor E. Bouvier, of Paris, has led to the conclusion, that all these species, as well as the new one to be described herein, possess a type of male copulatory organs, which is quite peculiar, and differs considerably from that seen in other species of the subgenus *Cambarus* (type: *C. blandingi*).

The description of this organ, as given by Faxon for his first and second groups, and by the present writer for the subgenus *Cambarus*, does not apply at all to these Central American and Cuban species.

An attempt has been made, in the paper referred to, to also include these forms in *Cambarus*, but, as is now evident, this is impossible. The material at hand when the paper was written was too poor (only one male of the second form of *C. digueti*) to decide the question, and, moreover, the description of these organs in *C. mexicanus* was not well understood, since no figure had been published.

However, Faxon's description of the male organs of *C. mexicanus* suddenly became clear to me when I compared it with the new species, and plainly these organs in these two species are very similar. Since good figures of those of the other two species have been published, it is now possible to give a correct account of these organs, and to point out their chief peculiarities.

Faxon's description of the male copulatory organs in his first and second group is as follows: "*Outer part truncate at the tip, and furnished with one to three small recurved teeth; inner part terminated by a short acute spine, which is generally directed outward.*"

For the subgenus *Cambarus*, I have given the following characters of the male organs: "*Sexual organs of male stout, more or less straight, and comparatively short, truncated or blunt at the tip, the outer part ending in one to three horny teeth, which are sometimes recurved, or compressed, or plate-like, and are always sharply distinguishable by means of the blunt end. Inner part terminated by a shorter or longer acute spine, which is sometimes distinct from the tip of this part, so that it appears two-pointed.*"

This latter description was framed with the desire to make it fit the species of the *digueti*-group; but it neglects the fact, that in these species the outer part of the male organs does not possess any horny teeth, as is generally the case in species of the type of *blandingi*. In the species of the *digueti*-group, it is the *inner* part that possesses, in the male of the first form, a single horny spine, which has a variable position in the different species, but is always highly characteristic for one and the same species. It has taken me some time to ascertain this fact; indeed, I admit that I may be mistaken in so far as that there is a remote possibility that this horny spine belongs to the outer part, since in the new species to be described here, its position is just at the point where the two parts (inner and outer) become distinguishable at the anterior margin of the organ; but after examining the condition in second form males of the new species and of *C. digueti*, I feel rather sure that this accessory tip, which is not horny and spiniform

in this case, but tuberculiform, belongs to the inner part. (Compare also Faxon's figure of *C. carinatus* = *digueti*, Proc. U. S. Mus. 20, 1898, pl. 63, f. 2.)

Thus this organ is fundamentally different from that of the subgenus *Cambarus* as represented by its type (*C. blandingi*), and, moreover, it possesses at its anterior margin, not far from the tip, a peculiar angular projection, which I have called the "shoulder." Such a shoulder is found in a few cases in other species belonging to the subgenus *Cambarus* (*C. clarki* and *troglodytes*), and in numerous species of the subgenus *Faxonius* (section of *C. propinquus*); but here it always has a different position, being quite remote from the tip of this organ.

Thus I think we are justified in emphasizing this peculiar feature of the male organs by creating for it a separate subgenus, for which the name *Procambarus* is proposed, and we consequently have now *five* subgenera within the genus. The diagnoses of the two first are as follows.

Procambarus subgen. nov.

Sexual organs of male stout, more or less straight and comparatively short, rather blunt at the end, but not truncate. The two parts in close opposition up to the tips. The outer one ending bluntly, without horny teeth; the inner one being more or less similar to the outer one, but possessing in various positions one horny spine. Anterior margin with a shoulder near the tips. In the male the third pereiopods have hooks.

Species: *digueti*, *williamsoni*, *mexicanus*, *cubensis*.

Cambarus (Ortmann *sens. restrict*).

Sexual organs of male stout, more or less straight and comparatively short, very blunt, or truncated at the end. The two parts in close opposition, with exception of the terminal spines. The outer part ending in one to three horny teeth, which are often recurved, or compressed, or plate-like, being sharply distinguishable from the blunt end. Inner part terminated by a shorter, or longer, acute spine. A shoulder on the anterior margin is rarely present, and it is, if present, quite remote from the tip. In the male the third, or the third and fourth, pereiopods have hooks.

The diagnoses of the other three subgenera: *Cambarellus*, *Faxonius*, *Bartonius*, do not require any change.

Thus, from my subgenus *Cambarus*, certain species are removed as the subgenus *Procambarus*, which would belong to Faxon's second group: but not the whole of Faxon's second group belongs to *Procambarus*, since the other species, which I have designated (*l. c.*) as the *simulans*-group and the section of *C. gracilis*, possess sexual organs that entirely correspond to those of the section of *C. blandingi*. In the subgenus *Cambarus*, consequently, three sections remain:

Section of C. simulans:

Male with hooks on third pereiopods. Areola rather narrow, but never obliterated in the middle, slightly longer than half of the anterior section of the carapace. Chelæ elongated and subcylindrical.

Species: *simulans*, *gallinas*.

Section of C. gracilis:

Male with hooks on third pereiopods. Areola obliterated in the middle, considerably longer than half of the anterior section of carapace. Chelæ short, broad, ovate.

Species: *gracilis*, *hagenianus*, *advena*.

Section of C. blandingi:

Male with hooks on third and fourth pereiopods. Areola wide, or narrow, rarely obliterated in the middle, shorter, or longer. Chelæ generally elongated, narrow and subcylindrical.

Divided into four groups, containing together about 15 species.

The species of the subgenus *Procambarus* are easily distinguished by the following characters:

a_1. Inner face of male sexual organs flattened, but not broadly dilated.

b_1. Sexual organs of male slightly curved backward at apex; horny spine of inner part straight, situated posterior to the tip of the outer part. Rostrum carinated above. Carapace with one lateral spine on each side. *C.* (*Procambarus*) *digueti* Bouvier.

b_2. Sexual organs of male straight; horny spine of inner part curved, situated anterior to the tip of outer part. Rostrum not carinated above.

c_1. Rostrum with marginal spines. Carapace with two lateral spines on each side. *C.* (*Procambarus*) *williamsoni* spec. nov.

c_2. Rostrum without marginal spines. Carapace without marginal spines. *C.* (*Procambarus*) *mexicanus* Erichson.

a_2. Inner face of male sexual organs flattened and greatly dilated, forming a broad, flat, setose plate. Rostrum not carinated, with marginal spines. Carapace without lateral spines. *C.* (*Procambarus*) *cubensis* Erichson.

DESCRIPTION OF NEW SPECIES.

CAMBARUS (PROCAMBARUS) WILLIAMSONI spec. nov.

Diagnosis. — Male sexual organs with the outer part blunt, the inner slightly longer than the outer, narrower, but blunt; in the first form with a horny, procurved spine at the anterior margin, which is represented by a blunt tubercle in the male of the second form. The inner face of inner part slightly dilated and flattened, with two rows of bristles diverging from a low oblique rib. Rostrum with distinct lateral spines, acumen short; its upper surface subplane, without keel. Sides of carapace granulated, with two spines on each side behind the cervical groove. Areola very narrow, about half as long as the anterior section of the carapace. Chelæ long, subcylindrical, thickly squamoso-granulated, the granulations larger on inner side of the carpopodite and hand, only in young specimens with an indistinct spine. Finger shorter than the palm. Third pair of pereiopods with hooks in the male.

Description of Male of First Form. — *Rostrum* subplane, without median keel, margins slightly elevated, convergent, with a distinct lateral spine on each side a short distance from the tip. Acumen short, triangular, with a fringe of stiff hairs. *Postorbital ridges* divergent posteriorly, ending in a small spine anteriorly. *Carapace* laterally compressed, suborbital angle rounded. Branchiostegal spine distinct. Sides of carapace finely, but distinctly granulated; two sharp lateral spines on each side behind the crevical groove. *Areola* about half as long as the anterior section of carapace, including the rostrum, very narrow in the middle, with a single irregular row of punctations. *Abdomen* as broad as, and slightly longer than, carapace; epimera rounded; anterior section of telson with two spines on each side. Anterior end of *epistoma* broadly triangular. *Antenna* with the flagellum longer than the carapace, but shorter than the whole body. Antennal scale broad, broadest in the middle. *Chelæ* subcylindrical, long, thickly beset with squamiform granulations, which are largest on the inner side. Fingers not gaping, shorter than palm, granulated, and indistinctly longitudinally costate on upper side; slightly pubescent at the cutting edges, and with a few longer hairs. Carpopodite without sulcus above, granulated like hand, granules largest on inner side, but not spiniform (with exception of young specimens, where there is a small spine at the distal end of inner margin). Meropodite

granulated, almost smooth on proximal parts of outer and inner side, with a small spine near distal end above. Lower side with two rows of spiniform granulations, most distinct in young individuals. Ischiopodite of the *third pair of pereiopods* with a strong hook. *Copulatory organs* (first pair of abdominal appendages) short and straight, with a prominent shoulder on the anterior margin near the tip. Outer and inner part in close apposition to their tips; outer part ending bluntly, the inner slightly longer and thinner, but also blunt. The inner part carries, at its anterior side, not far from the shoulder, a small, procurved, horny spine. Inner face of inner part flattened, and slightly dilated, with two rows of bristles, which diverge from a low, oblique median rib.

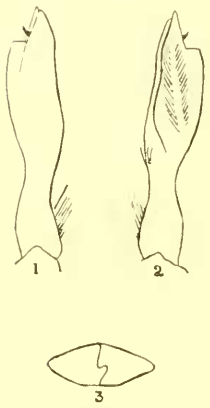

FIG. 1. Male copulatory organ of right side seen from outside. FIG. 2. Male copulatory organ of right side seen from inside. FIG. 3. Annulus ventralis of female. All figures enlarged twelve diameters.

The male of the second form differs in the less distinctly granulated carapace; the chelæ are weaker; the hooks of the third pereiopods smaller; the copulatory organs are similar, but the horny, procurved spine is replaced by a blunt tubercle that is not horny. (This gives the whole organ three blunt tips.)

Female: Similar to the male of the second form. *Annulus ventralis* transversely rhomboid, forming a simple tuberculiform elevation, with an S-shaped longitudinal fissure, but without any depressions.

Locality: Los Amates, Province of Izabal, Guatemala. In small streams and swales. January 20, 1905; collected by E. B. Williamson, of Bluffton, Ind. (About 4 to 5 miles due south of the town of Izabal, south of Rio Malagua.)

There are 27 specimens in the lot, 13 ♂, 14 ♀. Only one (the largest) is a male of the first form. Most of the specimens are very young.

The *measurements* of the largest ♂ (I) and ♀ are as follows:

♂. Total length 51.5 mm., carapace. 25 mm., anterior section of carapace 16.5 mm., areola 8.5 mm., width of areola in the middle 0.5 mm., abdomen 26.5 mm., length of hand 20 mm., of palm 11 mm., of fingers 9 mm.

♀. Total length 49.5 mm., carapace 24.5 mm., anterior section of carapace 16 mm., areola 8.5 mm., width of areola in the middle 0.5

mm., abdomen, 25 mm., length of hand 13 mm., of palm 7 mm., of fingers 6 mm.

The specific name is given in honor of the discoverer, Mr. E. B. Williamson. Before Mr. Williamson started for Guatemala, I called his attention to the possible presence of a *Cambarus* in this country, and his search was rewarded by the discovery of this species.

REMARKS ON THE GEOGRAPHICAL DISTRIBUTION.

The existence of a *Cambarus* in Guatemala (Coban, Alta Vera Paz) was first mentioned by Huxley (1878), but the species has never been described. It remains doubtful whether the present species is the same, since it comes from another part of the country, although both localities belong to the Atlantic slope.

Cambarus williamsoni is sharply distinguished from all other species of the genus, although it forms a natural group (subgenus *Procambarus*) with three other species, two of which are found in Mexico (*digueti*, *mexicanus*), and the third in Cuba (*cubensis*). The most closely allied form is *C. mexicanus*, but this is apparently more highly specialized, as is shown by the lack of the marginal spines of the rostrum and the lateral spines of the carapace. Thus *C. williamsoni* is to be regarded as a rather primitive form, and stands between *C. digueti* and *C. mexicanus*. I have regarded *C. digueti* as the most primitive form of the whole genus; but second to it is *C. williamsoni*. *C. mexicanus* comes very close to the latter, while *C. cubensis* is more remote from the rest on account of the broadly dilated inner face of the male organs; but the beginning of the development of this feature is clearly indicated in the other three species.

Thus it is beyond doubt, that *C. cubensis* points in its affinities to Guatemala and Mexico, and our Guatemalan species indicates the way by which Cuba was populated. In my paper referred to (*Proc. Am. Phil. Soc.*, 49, 1905), I have already assumed this connection on the map, without knowing anything of the existence of *C. williamsoni*, and this assumption has been fully confirmed by the discovery of this species.

The subgenus *Procambarus* appears to be the earliest type of the genus, and its range is in the original home of the genus (Mexico and Guatemala), with the exception of *C. cubensis*, which apparently is an early emigrant.

The separation of the subgenus *Procambarus* from the rest of the

genus, chiefly from the typical subgenus *Cambarus*, renders the Mexican crayfish-fauna rather peculiar. In Mexico, two well known subgenera are represented: *Procambarus* and *Cambarellus*. The first one has no representatives at all in the United States, while *Cambarellus* has only one (in Louisiana). There remains a Mexican species, *C. wiegmanni*, which has been placed with species of the true subgenus *Cambarus*, but its position is quite uncertain, the male copulatory organs being unknown.

CARNEGIE MUSEUM,
June 10, 1905.